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## ORIGINAL PAPER

# Cost of low back pain in Switzerland in 2005

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**Abstract** Low back pain (LBP) is the most prevalent health problem in Switzerland and a leading cause of reduced work performance and disability. This study estimated the total cost of LBP in Switzerland in 2005 from a societal perspective using a bottom-up prevalence-based cost-of-illness approach. The study considers more cost categories than are typically investigated and includes the costs associated with a multitude of LBP sufferers who are not under medical care. The findings are based on a questionnaire completed by a sample of 2,507 German-speaking respondents, of whom 1,253 suffered from LBP in the last 4 weeks; 346 of them were receiving medical treatment for their LBP. Direct costs of LBP were estimated at €2.6 billion and direct medical costs at 6.1% of the total healthcare expenditure in

Switzerland. Productivity losses were estimated at €4.1 billion with the human capital approach and €2.2 billion with the friction cost approach. Presenteeism was the single most prominent cost category. The total economic burden of LBP to Swiss society was between 1.6 and 2.3% of GDP.

**Keywords** Low back pain · Cost-of-illness · Switzerland · Human capital · Friction cost · Presenteeism

**JEL Classification** I11

## Introduction

Low back pain (LBP) is the most prevalent health problem in Switzerland. A large population survey carried out in Switzerland in 2007 revealed that 47% of women and 39% of men had suffered from various back problems in the preceding 4 weeks; this represented the highest prevalence of all the major health problems surveyed (Swiss Federal Office of Statistics [9]).

To our knowledge no studies have assessed the economic consequences of LBP in Switzerland from a societal perspective. This was the aim of the present study.

Studies that estimate the economic burden of disease are known as cost-of-illness (COI) studies [23, 36]. While some COI studies are limited to the costs accruing to insurance companies or the public healthcare system, in the case of LBP a societal perspective is of particular interest, because it considers the costs incurred by the individuals affected and the productivity losses for the economy. It is likely that these costs represent an important share of the economic burden of LBP since self-help is a frequent management strategy for LBP and a large number of workdays are lost to LBP [24].

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In a recent systematic review Dageneais et al. [14] located 27 relevant studies published between 1997 and 2007 on the cost of LBP in industrialized countries (see Maetzel and Li [30] and Asche et al. [1] for earlier reviews). The methodology, cost components considered, and definition of LBP differed considerably from study to study. Only 9 studies had considered direct costs as well as productivity losses, and the number of direct cost categories included varied between 4 and 10. All studies that had considered productivity losses had taken into account absenteeism due to sick leave, but only a few had considered early retirement, presenteeism (reduction of productivity whilst still being at work), and lost productivity in the household (e.g. child care, cleaning, and cooking). Presenteeism makes up the greatest proportion of the overall costs in many recurrent or chronic conditions [12, 20].

Cost-of-illness studies can be incidence-based or prevalence-based and follow a top-down or a bottom-up approach [39]. In line with most COI studies, in the present study we adopt a *prevalence-based* approach, which is considerably easier to implement as it simply records the costs accruing due to a disease within a given time span, usually one year. Contrary to most COI studies, we adopt a *bottom-up* approach, which permits the measurement of costs with great detail and includes out-of-pocket expenses and non-medical direct costs, which cannot be captured in top-down studies [45].

Our study is based on a very broad data collection that includes 15 direct cost categories and 3 productivity loss categories. It includes costs that are not usually considered, such as expenditure for utility devices (e.g. mattresses, chairs), physical training, alternative medicine, and assistance in activities of daily living (ADL) by professionals, family, or friends, all of which are often not reimbursed by the health insurance provider [16]. These costs may be particularly important because many of the individuals affected are not under professional medical treatment [44]. The information collected thus allows a thorough assessment of the true costs of LBP.

## Materials and methods

Our study is primarily based on a large survey carried out using a self-administered questionnaire in the German-speaking part of Switzerland in 2005. Additional cost information was collected using a weekly pain diary and a bi-monthly cost diary administered over a 12-month period in a subsample of the respondents to the main questionnaire.

### Selection of participants

In 2003 the MEM Center of the University of Berne carried out a major population-based musculoskeletal health

survey with a questionnaire sent to 23,673 German-speaking individuals over the age of 18 of which 16,634 (70.3%) returned it. The prevalence of LBP in the previous 4 weeks was 24.3%. The present study was nested in this cross-sectional sample and participants were randomly selected after primarily stratifying for the presence of LBP according to the responses to the 2003 survey and a short telephone interview in 2004.

### Questionnaires

The main questionnaire consisted of 260 standardized, closed questions covering the sociodemographic characteristics of the respondents, their health status, and the following LBP-specific items: presence and frequency of LBP, reasons for LBP, pain medication, pain intensity, use of healthcare services because of LBP, prevention activities, limitations in ADL, need for assistance, absence from work and reduced productivity at work, disability pension, and beliefs regarding LBP [33].

The weekly pain diary consisted of 10 standardized, closed questions covering pain intensity and frequency, use of medical resources (pain medication, visits to the general practitioner, physiotherapist and other therapists), absence from work, reduced productivity at work, and reduced abilities in leisure activities. The bi-monthly cost diary contained 37 open and closed questions covering the use of medical resources, prevention activities, absence from work, use of utility devices, and other expenses.

Most of the items in the questionnaires were taken from previous population-based surveys and had been previously validated. The item regarding visits to the general practitioner, for example, was validated by Patel et al. [35], and the item on self-reported absenteeism due to illness by Severens et al. [41]. Questions regarding healthcare utilization, absenteeism, and presenteeism were in part derived from the PRODISQ questionnaire [27] validated on employer data. The primary reference time-frame of “in the last 4 weeks” was shorter than that used in most other surveys and was expected to ensure high reliability of the answers [43].

### Direct costs

The questionnaire covered a vast array of direct medical cost elements associated with the treatment of LBP (see Table 1), such as visits to the general practitioner and specialists, different types of therapy, pain medication, surgery, inpatient hospital stays, and expenditure for utility devices and physical training connected with the treatment and prevention of LBP. Basic health insurance is compulsory for every Swiss resident (‘Grundversicherung’). In 2005, approximately 85 public health insurance companies

**Table 1** Direct cost items: proportion of individuals with LBP using these, and unit prices

Direct cost component connected with LBP	Percentage of LBP of sufferers	If yes		Unit price/tariff €		Source of price/tariff information
		Mean	SD	Price/tariff	Unit	
Medication (medical care and self care): used by 28.1% of LBP sufferers in last 4 weeks						
Pain medication in last 4 weeks at least once	28.1			0.3	Dose	Weighted average based on data disclosed in a cost diary by LBP sufferers. Prices according to Swiss drug price compendium (price of smallest package, Arzneimittelkompendium der Schweiz, Morant 2005)
1–4 times a month	13.2					
2–6 times a week	7.1					
Once a day	4.2					
Several times a day	3.5					
Medical care (outpatient): used by 22.8% of LBP sufferers in last 4 weeks						
Visit to general practitioner in last 4 weeks	11.6	1.8	1.3	49.7	Visit	Average for “general medicine” and “general practitioner” from s-pool
Visit to specialist in last 4 weeks	6.4	2.4	2.0	93.7	Visit	Average for “neurology”, “orthopaedic surgery and traumatology” and “rheumatology” from s-pool
Physiotherapy session in last 4 weeks	7.6	6.4	4.1	33.0	Session	S-pool
Other therapy (e.g. chiropractic) session in last 4 weeks	9.3	2.7	2.1	51.7	Session	Own estimation based on telephone interviews with therapists
MRI examination in last 4 weeks	0.6	1.4	0.8	401.2	Test	SWICA database for the period 1 Jan 2004 to 31 Oct 2005
CT examination in last 4 weeks	0.3	1.5	1.0	528.4	Test	
Medical care (inpatient): used by 8.6% of LBP sufferers in last 12 months						
Inpatient hospitalization in last 12 months <sup>a</sup>	6.0	7.2	2.8	500.0	Day	Average for “internal medicine” from s-pool, multiplied by 2 to reflect public financing of hospitals
Surgery in last 12 months	4.2			621.5	Day	S-pool
Outpatient hospital visit in last 12 months	2.6	1.0	0.17	234.5	Day	Average for “rehabilitation” from s-pool, multiplied by 2 to reflect public financing of hospitals
Rehabilitation clinic stay in last 12 months	2.3	20.0	7.7	421.2	Day	
Cure stay in last 12 months	1.7	15.0	0.0	156.3	Day	Accommodation cost: average price per day from price list of Association of Swiss Health Resort institutions (Wohlbeinden Schweiz)
Assistance, prevention, and utility devices						
Dependent on assistance in last 4 weeks (number of days)	6.9	6.5	7.7	14.6	Hour	Estimation of gross hourly earnings for housework in Schön-Bühlmann [29]
Expenditures for physical training in last 12 months <sup>b</sup>	22.0	615.1	496.2		€	Individual specifications in questionnaire
Expenditures for utility devices in last 4 weeks	7.5	295.7	562.2		€	Individual specifications in questionnaire

Sample of 1,253 individuals with LBP in the last 4 weeks

Original prices in CHF, € values calculated with mean 2005 exchange rate (0.646 €/CHF, Swiss National Bank)

S-pool santésuisse (national association of health insurers) datapool, German speaking cantons, 2005, SWICA private health insurance company, SD standard deviation

<sup>a</sup> Self-reported data regarding hospital days are rather incomplete and inconsistent, which is probably due to an ambiguous wording and display of the item in the questionnaire. We therefore decided to rely on the following average number of hospital days of LBP patients provided by the Hirslanden Hospital Group: 9 days if the patient had surgery and 3 days in case of no surgery

<sup>b</sup> In the cost calculations we assume that only 50% of expenses for physical training are actually aimed at curative or preventive back pain training while the other 50% can be assigned to general fitness

(‘Krankenkassen’) were entitled to provide this uniform ‘health benefit basket’. The insurance providers are financed by individual insurance premiums. All insurers together form the Association of Swiss Health Insurance Companies (santésuisse), which negotiates fees and rates of reimbursement on their behalf.<sup>1</sup>

The equivalent costs of outpatient medical visits and outpatient physiotherapy sessions, as well as average daily rates for inpatient hospitalization, surgery, inpatient rehabilitation, and outpatient hospital visits were provided by the datapool of santésuisse. For details see also the last column in Table 1.

The consumption of pharmaceuticals was estimated on the basis of the weighted average of quantities recorded by LBP sufferers in a cost diary. From that, the prices for medicines were calculated according to the Swiss drug price compendium. The smallest package size has been taken as the basis, considering that in outpatient care approximately 85% of LBP sufferers purchase analgesic medications over the counter (OTC), and these are available to the public in small package size only. In inpatient care, costs for pharmaceuticals are included in the daily fee anyway.

An important non-medical direct cost covered by the questionnaire was “assistance in ADL by professionals, family or friends”. Respondents who needed assistance in the last 4 weeks due to LBP were asked to report the type and number of hours of assistance received. The price of €14.60/h for such assistance was derived from a recent study estimating a shadow price by Schön-Bühlmann et al. [40] on behalf of the Swiss Federal Office of Statistics.

### Productivity losses

The measurement of productivity losses, often also called indirect costs, is a particularly controversial issue. Most studies apply the *human capital* (HC) approach, which measures productivity losses by multiplying the work-time lost as a consequence of illness by the gross earnings of the individuals affected. Some authors have suggested that the HC approach overestimates the productivity losses to society [15, 29]. The *friction cost* (FC) approach, in contrast, limits productivity losses to the time-span the employer needs to restore the initial production level, i.e. until the sick worker has been replaced [25, 28]. This time-span is called the friction period. As the FC method limits the productivity losses to the short run, these estimates are usually much lower than those made using the HC approach. In our study, we estimate productivity losses according to both modalities.

The following causes of productivity loss due to LBP were considered: absenteeism (temporary absence from work), presenteeism (reduced productivity of employees still at work despite illness), and permanent disability. The questionnaire contained two questions regarding absenteeism (“Were you absent from work in the last 4 weeks because of your back pain?” yes or no; if yes, how many days?) and two questions on presenteeism (“Was your work productivity in the last week impaired by your back pain?” yes/no; if yes, how much was your productivity impaired due to your back pain? 10 equal categories, from 10% to 100%), adapted slightly from similar questionnaires [18, 27]. Self-reported reduced productivity owing to musculoskeletal symptoms has been assessed in this way among about 1,000 computer users at 46 different work sites in Sweden. The two questions have been qualitatively validated through interviews of a sample of 50 employees and proved to be reliable [19]. Strong evidence of a quantitative link between self-reported presenteeism and actual productivity loss comes from several studies involving credit call centre employees in the USA. A number of objective measures of service representatives’ productivity correlated strongly with the employees’ self reports [20]. Such self-reported data have been found to be reliable and valid when the recall periods are short (1–2 weeks) [32]. The questionnaire also contained two questions on the receipt of a disability or accident insurance pension as a result of LBP (yes/no; if yes, to what extent? partial at 25% or 50% or full at 100%). Costs associated with hours of work lost were calculated using the respondent’s income before deductions.

In the HC approach we considered all workdays lost due to absenteeism and presenteeism by individuals engaged in a salary-paying occupation and due to permanent disability by individuals of working age. In the FC approach, we calculated the costs of presenteeism as in the HC approach. For the costs of absenteeism we assumed that individuals with absence from work due to LBP were replaced after a *friction period* of 22 weeks (as in the study by Boonen et al. [3] on chronic LBP and other musculoskeletal diseases). Costs of permanent disabilities due to LBP were not considered in the FC approach.

This calculation was based on the information on duration of the present LBP episode and the assumption that an average pain episode will last twice as long as it has lasted so far. This assumption prevented the underestimation of costs accruing from new LBP episodes (i.e. episodes that started less than 11 weeks ago) that would otherwise have occurred due to the retrospective nature of the survey. Extrapolation of productivity losses to the whole year considered the inverse probability of capturing a person with a given length of LBP episode in the survey (e.g. for a 26-week LBP episode the probability is 26/52 or

<sup>1</sup> For further details on the Swiss health care system see European Observatory on Health Care Systems [17].

50.0%). Only the productivity lost by employed individuals was considered. Following Koopmanschap and Rutten [28] we furthermore assumed that the productivity losses due to absenteeism were higher for workers with a higher education level, as it takes more time to hire and introduce these workers into the work place (coefficients according to highest education: 0.8 for basic school, 1.0 for apprenticeship or secondary school, and 1.2 for higher education). This may be a conservative estimate of true production losses; these losses would be even higher if it is considered that some of the absent employees work in teams, where the performance of all team members is affected by the absence of one of them [34]. Conversely, it may be an overestimation of production losses if the absence of single workers is partially absorbed by other team members [28].

### Extrapolation of results

Total costs of LBP in Switzerland in 2005 were calculated with the following procedure<sup>2</sup>:

- (1) Calculation of the yearly cost of LBP for an average LBP sufferer in Switzerland by multiplying the estimated average cost per individual with LBP in the last 4 weeks by 13 (13 multiplied by 4 weeks = 52 weeks).
- (2) Calculation of the yearly cost of LBP for an average individual with or without LBP by multiplying the yearly cost per LBP sufferer by the prevalence of LBP in the last 4 weeks according to the baseline survey in 2003 (24.3%).
- (3) Calculation of the total yearly cost of LBP in Switzerland by multiplying the average yearly cost of LBP by the size of the reference population in 2005 (5.7 million individuals over the age of 20).

## Results

The main questionnaire was sent to a total of 2,860 individuals over the age of 20 consenting to participate, 2,507 (87.7%) of whom returned it. The prevalence of LBP in the previous 4 weeks was 50.0% (1,253 individuals over the age of 20). The duration of the current episode of LBP was 4 weeks or more in 89.1% of the cases.

<sup>2</sup> The extrapolation is based on the assumptions that our sample is representative for all LBP sufferers in Switzerland and that suffering from LBP does not vary seasonally. Note that although the sample covers only the German speaking part of Switzerland, where 72.3% of the population lives, a large national health survey showed no significant differences in prevalence of LBP between the language regions in 2007 (Swiss Federal Office of Statistics [9])

The weekly pain diary and the bi-monthly cost diary were sent to a sub-group of 400 individuals consenting to participate. As much as 305 individuals filled out at least half of the weekly pain diaries and 201 individuals filled out at least 5 out of the 6 bi-monthly cost diaries. Unfortunately, the sub-group of the respondents to these two questionnaires was not large enough to contain a representative number of high-cost-generating LBP sufferers. Our calculation of the costs of LBP is thus entirely based on the responses to the main questionnaire, and the responses to the weekly pain diary and the bi-monthly cost diary were only used to validate these cost estimates and to determine the average cost of pain medications. Unless stated otherwise, the results are thus based on the responses to the main questionnaire.

In comparing the key sociodemographic characteristics of the individuals with LBP in the last 4 weeks with the corresponding values in the Swiss population over the age of 20, a number of differences emerged: first, our sample covered only the German-speaking part of Switzerland, where 72.5% of the total population live [7]. Second, the average age of individuals with LBP was 2.8 years above the population average of 49.6 years [10]. Third, the substantial number of immigrants in Switzerland was most probably underrepresented with only 6.0% of respondents having a foreign nationality (20.7% in the whole total population [10]). Fourth, compulsory education was the highest level of education achieved by just 10.1% of respondents over the age of 24 (22.8% in the whole population [6]).

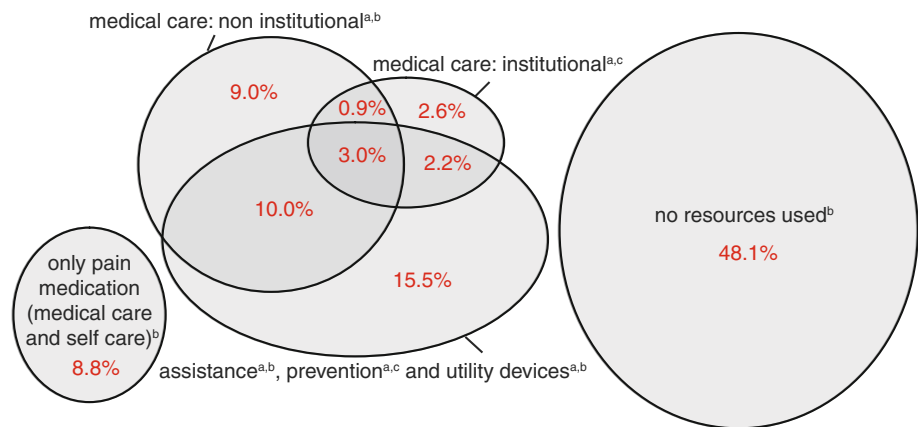
### Direct costs

The relative use of direct-cost components among respondents reporting LBP is summarized in Table 1. Pain medication was the most frequently used resource in the last 4 weeks with 28.1% of individuals adopting it as their exclusive treatment or in combination with other treatments. Outpatient medical care was used by 22.8% of individuals in the last 4 weeks with general practitioner consultations (11.6%), specialist consultations (6.4%), physiotherapy (7.6%), and other types of therapy (9.3%) being the most frequently used resources. Inpatient medical care was used by 8.6% of individuals in the last 12 months and included inpatient hospitalization (6.0%), surgery (4.2%), outpatient hospital visits (2.6%), and stays in a rehabilitation clinic (2.3%). Self-help was frequent with 22.0% of individuals incurring expenditure for physical training in the last 12 months and 7.5% for utility devices in the last 4 weeks. Furthermore, 6.9% of individuals had relied on a person to assist them in their ADL for an average of 6.5 h a week.

Figure 1 gives a graphical representation of the percentages of LBP sufferers using specified combinations of



**Fig. 1** Percentage of LBP sufferers using specified health care resources. Total area of circles corresponds to 100% of 1,253 individuals with LBP in last 4 weeks. *a* With and without use of pain medication; *b* in last 4 weeks; *c* in last 12 months



health care resources or no resources at all. Nearly half of the individuals suffering from LBP in the last 4 weeks (48.1%) did not seek any treatment in this time period. Self-help was important because a part of the expenses incurred by the 8.8% of LBP sufferers exclusively using pain medication and the 15.5% using only assistance, prevention, or utility devices is not covered by health insurance.

Average direct costs for an individual reporting LBP in the last 4 weeks amounted to €1,842 and total direct costs of LBP in Switzerland amounted to €2.6 billion in 2005 (Table 3). Original prices were in CHF and euro values were calculated with the mean 2005 exchange rate of 0.646 €/CHF (Swiss National Bank). The most important direct-cost component was assistance for ADL (18.3% of direct costs). Physiotherapy (11.2% of direct costs), other types of therapy (9.3%), visits to the specialist (10.3%), and the general practitioner (7.5%) also represented important direct cost components, as did inpatient hospitalizations (11.8%) and stays at rehabilitation clinics (10.6%). Expenditures for utility devices, which may well have included substantial out-of-pocket expenditures, amounted to 10.1% of direct costs.

#### Productivity losses

Table 2 gives an overview of the productivity losses among the economically active individuals of working age reporting LBP: 4.4% were absent from work in the last 4 weeks because of LBP, missing an average of 8.2 work days. LBP-related presenteeism in the last week was reported by 19.7% respondents (158 of 801 individuals), corresponding to an average productivity loss of 27.7%. Permanent disability due to LBP was reported by 3.7% of respondents receiving a disability pension and 0.6% an accident insurance pension. The average extent of disability pension received was 76.7% for disability pensions and 82.0% for accident insurance pensions. Payments for disability pensions were not considered in the calculation

of total costs, as they represent a transfer of income and not a resource consumption.

Productivity losses differed substantially depending on the method of calculation used (Table 3): average productivity loss in association with LBP amounted to €2,926 using the HC approach and just €1,571 using the FC approach. Productivity losses were dominated by the costs of presenteeism in both the HC approach (44.1% of total) and the FC approach (82.2%).

#### Total costs

Total costs of LBP were calculated as the sum of the total direct costs (€2.6 billion) and the total productivity losses, and varied between €6.6 billion (HC approach) and €4.8 billion (FC approach). Productivity losses amounted to 61.4 and 46.0% of these total costs, respectively.

The distribution of costs was highly skewed, with 48.1% of individuals with LBP in the last 4 weeks reporting no direct costs and 10% being responsible for 70% of the direct costs (Fig. 2). The distribution of productivity losses was even more skewed with 84.3% of individuals having no costs and 5% being responsible for 73.4% of the productivity losses (HC approach).

#### Breakdown of costs by level of pain

A breakdown of costs of LBP by the level of pain experienced in the last 4 weeks, on a scale from 0 (no pain) to 6 (unbearable pain), gives important insights into the single cost categories (Figs. 3, 4). As expected, the number of LBP sufferers incurring costs, as well as the average amount of costs, increases in step with the level of pain. Although direct costs are the most frequent cost category, up to one-fifth of the individuals with substantial pain do not cause direct costs (Fig. 3). The percentage of individuals with direct costs increases linearly from 30% at pain level 1 to 86% at pain level 6. The prevalence of

**Table 2** Productivity losses due to LBP by economically active individuals of working age

	Percentage of LBP sufferers in working age	If yes	
		Mean	SD
Absence due to LBP in last 4 weeks (no. of days)	4.4	8.2	10.7
Impaired productivity at work due to LBP in last week	19.7		
Extent of reduction of productivity at work (%) <sup>a</sup>		27.7	24.0
Duration of current pain episode (no. of days)		16.4	22.9
Up to 7 days	32.7		
8–14 days	8.5		
15–21 days	4.9		
More than 21 days	53.9		
Receiving disability pension (IV)	3.7		
Extent of disability pension (%) <sup>b</sup>		76.7	27.8
Number of months since first receiving pension		59.0	73.1
Receiving accident insurance pension (SUVA)	0.6		
Extent of accident insurance pension (%) <sup>b</sup>		82.0	20.5
Number of months since first receiving pension		43.2	32.4

A total of 801 economically active individuals of working age (<64 years for women, <65 years for men)

Lost work hours are valued at gross income before deductions

SUVA Swiss public accident insurance company covering large part of working population, IV Swiss National disability pension which covers whole population

<sup>a</sup> Reduction of productivity on a scale from 10 to 100% (interval steps 10, 20, ..., 100%)

<sup>b</sup> Full pension = extent of 100%

individuals with presenteeism increases from 4% at pain level 1 to 46% at pain level 5 and then decreases to 27% at pain level 6. This surprising phenomenon can be explained by the fact that presenteeism represents a point somewhere in between the continuum from 'optimal efficiency at work' to 'absence'. On average, individuals with presenteeism outnumber the individuals absent from work because of pain by a factor of 4.5. In the lower pain categories the individuals working with reduced capacity outnumber the absentees by a factor between 8 and 12. However, with higher intensity of pain, the proportion decreases to 3.5 in pain level 4, to 2.4 in pain level 5 and <1 in pain level 6. When pain becomes unbearable at work, the majority will stay at home and the prevalence of presenteeism diminishes, resulting in a decrease of presenteeism in relation to absenteeism at higher pain levels. Absenteeism is marginal at low pain levels, but then rises from 10% of individuals at pain level 4 to 43% at pain level 6.

Figure 4 shows the average direct cost and the average costs of absenteeism and presenteeism according to the HC approach among the economically active LBP sufferers of working age. Presenteeism is the most important cost category from the moderate pain level of 2 to the high pain level of 5. Costs of absenteeism are of no importance at lower pain levels, but substantial at higher pain levels. Absenteeism replaces presenteeism as the dominant cost

factor only among the small number of individuals with unbearable pain (0.9% of total).

### Sensitivity analysis

An 'extreme value' sensitivity analysis was carried out to verify the robustness of our results [4]. For direct costs we computed the values delimitating the 95% confidence interval around the estimated means ( $\pm 1.96$  standard errors calculated by bootstrapping) of the quantities of direct cost components and thus calculated a lower bound of total direct costs of €1.78 billion and an upper bound of €3.36 billion. Following a similar procedure for productivity losses, we calculate a lower and upper bound of €3.32 billion and €4.84 billion for the HC approach and of €1.67 billion and €2.71 billion for FC approach.

An additional sensitivity analysis of the estimated productivity losses appears useful because of the ongoing debate as to which cost-components should be included in the calculation and which estimation method used. The costs of presenteeism, which represent the most important productivity loss category according to our estimate, have rarely been assessed in other studies [5, 46]. Respondents may overestimate the loss of productivity due to LBP if they take productivity at 100% as the reference value, which is a level that is seldom achieved at a workplace even in the total absence of LBP. Under the conservative

**Table 3** Total cost of LBP in Switzerland in 2005

	Cost per year per LBP sufferer in €	Total cost LBP in Switzerland in million €	Percentage of GDP	
Total cost with HC approach	4,768	6,648	2.3	
Total cost with FC approach	3,413	4,758	1.6	
			Percentage of direct cost	
Total direct cost	1,842	2,568	100.0	
Pain medication (medical + self care)	20	27	1.1	
Medical care: outpatient	771	1076	41.9	
Visits to general practitioner	138	193	7.5	
Visits to specialist	190	264	10.3	
Physiotherapy sessions	206	288	11.2	
Other therapy sessions	171	238	9.3	
MRI examination	42	58	2.3	
CT examination	25	35	1.4	
Medical care: inpatient	483	674	26.2	
Inpatient hospitalization	217	302	11.8	
Surgery	26	37	1.4	
Outpatient hospital visits	6	9	0.3	
Rehabilitation clinic stay	195	271	10.6	
Cure stay	39	55	2.1	
Assistance, prevention, utility devices	567	791	30.8	
Physical training	44	61	2.4	
Utility devices	186	260	10.1	
Assistance for ADL	337	471	18.3	
			Percentage of production losses	Percentage of total cost
Production losses HC approach	2,926	4,080	100.0	61.4
Absenteeism LBP sufferer	493	688	16.9	10.4
Presenteeism LBP sufferer	1,292	1,801	44.1	27.1
Permanent disability	1,141	1,591	39.0	23.9
Production losses FC approach	1,571	2,190	100.0	46.0
Absenteeism LBP sufferer	279	389	17.8	8.2
Presenteeism LBP sufferer	1,292	1,801	82.2	37.9

Original prices in CHF, € values calculated with mean 2005 exchange rate (0.646 €/CHF, Swiss National Bank)

Population prevalence of LBP according to year 2003 survey by MEM Center of University of Bern: 24.3%

Reference population of individuals over the age of 20 in year 2005: 5,737,935 individuals

Details of cost calculation (absenteeism for FC only if duration of current pain is less than 11 weeks)

absenteeism = daily gross income × number of days off work due to LBP in last 4 weeks

presenteeism = gross income per week/number of workdays per week × (number of workdays per week – number of absent workdays in week) × degree of work inefficiency for days in current period of pain duration

disability = estimated gross income per week × (job workload – disability-adjusted job workload) × 4

ADL activities of daily living, HC human capital, FC friction cost

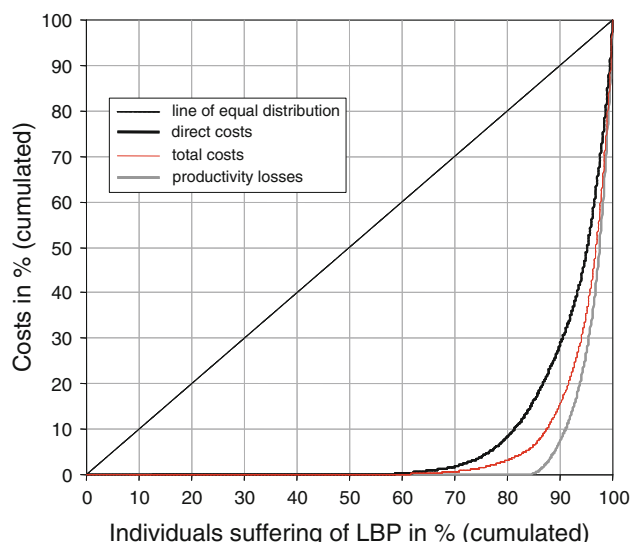
assumption that the actual productivity lost due to presenteeism amounted to only half of the value declared by respondents, total productivity losses are reduced by 22% for the HC approach and 41% for the FC approach.

The results of the sensitivity analysis are summarized in Fig. 5.

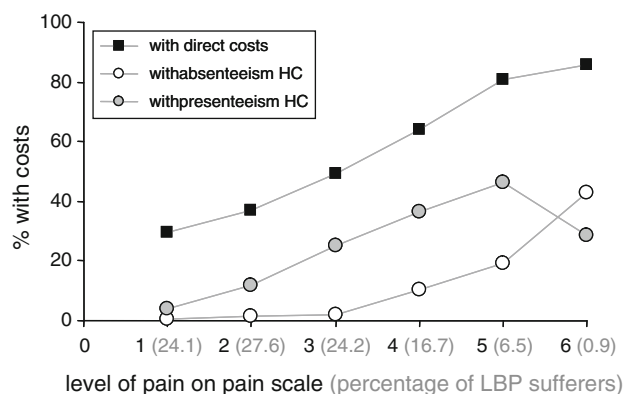
## Discussion

This study estimated the total cost of LBP in Switzerland from a societal perspective using a bottom-up prevalence-based cost-of-illness approach. The findings were based on a questionnaire completed by a large sample of individuals





**Fig. 2** Distribution of costs according to human capital approach

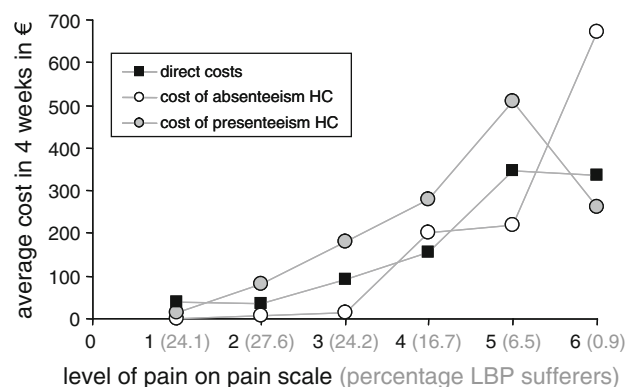


**Fig. 3** Percentage of LBP sufferers with costs by level of pain and type of cost (economically active LBP sufferers of working age). Level of pain on a scale from 0 (no pain) to 6 (unbearable pain). A total of 801 economically active individuals in working age. HC according to human capital approach

suffering from LBP. Total direct costs were estimated at €2.6 billion, and productivity losses at €4.1 billion according to the HC approach and €2.2 billion according to the FC approach.

#### Economic and social magnitude of costs

A comparison with the gross domestic product (GDP) and the total healthcare expenditure is useful to understand the magnitude of the cost of LBP in Switzerland. Using the HC approach, the total costs of LBP equated to 2.3% of the Swiss GDP in 2005; using the FC approach, they amounted to 1.6% of the GDP. These figures must, however, be considered with care, as the productivity lost due to LBP



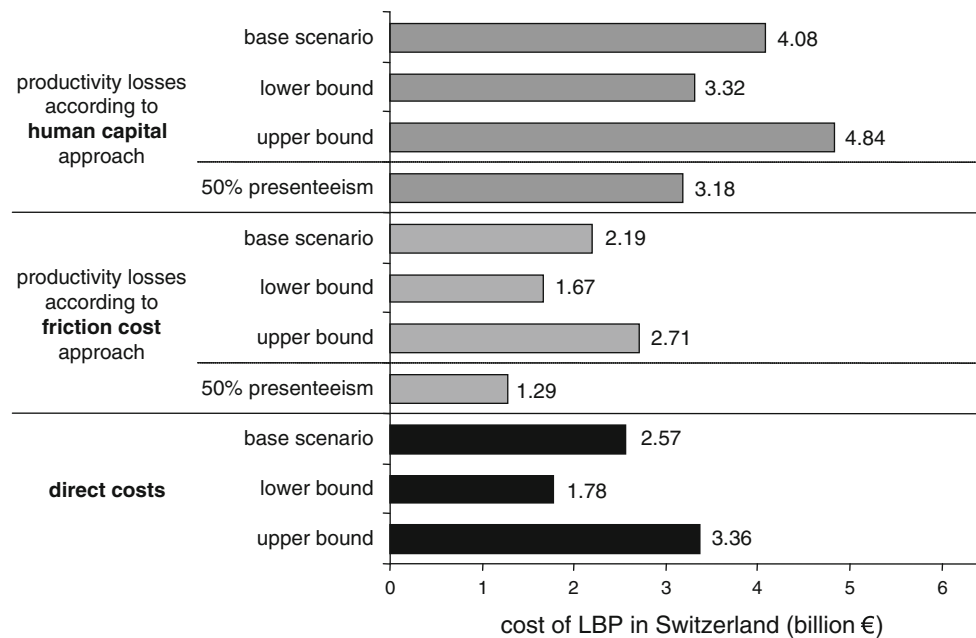
**Fig. 4** Average cost in last 4 weeks by level of pain and type of cost (economically active LBP sufferers of working age). Level of pain on a scale from 0 (no pain) to 6 (unbearable pain). A total of 801 economically active individuals in working age. HC according to human capital approach

and the value of assistance to individuals affected by LBP are not considered in the estimation of GDP.

The total healthcare expenditure in Switzerland in 2005 was €33.6 billion or 11.2% of the GDP [8]. Our estimate of the medical direct costs due to LBP (direct costs excluding assistance for ADL) was €2.1 billion, which corresponds to 6.1% of the total healthcare expenditure. This is a considerable proportion and is comparable to the relative cost of dental healthcare (6.2% of total), which represents an important medical expense for many households.

A considerable share of the direct costs is borne directly by the patients themselves and their families; the costs of alternative therapy sessions, expenses for utility devices, cures and physical training, and assistance provided by family and friends represent 42.2% of direct costs and are only partially covered by health insurance or by public financing. In addition, a substantial part of the expenses for medical care is paid by patients through co-payments and deductibles. In 2005, cost participation by the insured amounted to 14% of total medical expenditures by Swiss health insurers [8], which implies that an additional 8.2% of the direct costs of LBP were covered by patients themselves. Therefore, approximately 45% of the direct costs of LBP were borne directly by the patients and their families.<sup>3</sup>

<sup>3</sup> Calculation share of direct costs sustained directly by patients and their families: (other therapy sessions + cure stay + assistance, prevention, utility devices) = 42.2% of total direct costs ((expenses for inpatient and outpatient medical care by health insurance) multiplied with the average cost participation by the insured according to national health care statistics) = 8.3% of total direct costs.



**Fig. 5** Sensitivity analysis of costs of LBP in Switzerland

### Plausibility of results

In order to cross-check the plausibility of our direct cost estimates, we compared our results with national health-care cost statistics for the year 2005 [8]. In doing so, some of our direct cost components appeared implausibly large: our estimate of the costs of *physiotherapy sessions* were equivalent to 65.8% of the total corresponding national expenditure, *other therapy sessions* to 216.6%, and stays at a *rehabilitation clinic* to 54.5%. Our estimate of expenditure for utility devices also appeared very large.

Several factors may be responsible for this discrepancy: first, our sample may be affected by a self-selection bias as individuals with more severe LBP and higher resource use may be more inclined to take the time to respond to the questionnaire. A similar selection bias was also apparent when the health care use of the respondents to the main questionnaire was compared with that of the respondents to the weekly pain diary. The average proportion of LBP sufferers seeking physiotherapy sessions was 10.1% in the last week for the pain diary and 7.6% in the last 4 weeks for the main questionnaire. Thus, it appears that, in general, the more demanding the survey, the higher the proportion of individuals with severe problems (and thus higher costs) that volunteer to participate.

Second, individuals affected by LBP often seek alternative medical therapies which are only partially considered in the national health cost statistics, as they are frequently not regulated by health care authorities and their services are not reimbursed by health insurers. The respondents to the bi-monthly cost diary reported a total of

100 visits to physiotherapists (144 treatment sessions) and 87 visits to practitioners of alternative medicine (100 treatments) in the past week. As the average cost of an alternative treatment (€51.8 according to the responses to the pain diary) is higher than that of a physiotherapy session, the high costs due to *other therapy sessions* appear more plausible.

Although recent guidelines recommend the application of the FC approach (see for example von der Schulenburg [47]) it is questionable whether this is really the right approach to apply in Switzerland. The FC approach is based on the implicit assumption that there is an appreciable level of unemployment, which ensures that a worker who loses his job because of LBP will be replaced by someone who would otherwise have been unemployed. The relatively low unemployment rate of 3.7% in Switzerland in 2005, the high labour market participation of 67.0% [6] and the considerable immigration of workers from EU countries due to labour shortages tend to violate this assumption.

The breakdown of productivity losses reveals that permanent disability leads to high individual costs, but is relatively seldom. On the other hand substantial costs of presenteeism are mainly due to its relatively high frequency among individuals reporting LBP. This result confirms the supposition that presenteeism is of a greater importance than absenteeism as a cost factor [5, 12, 20, 46].

### International comparisons

The societal cost of LBP in Switzerland determined in the present study appears to be higher than that reported in

other studies for other countries [14]. However, this is mainly due to methodological differences between the studies and the choice of cost-components considered. In general, top-down COI studies generate much lower cost estimates as they include considerably fewer cost-category estimates. The average direct cost of LBP as a percentage of the GDP in the top-down studies included in the systematic review of Dagenais et al. [14] was reported to be just 0.3% while it was 0.9% in our study. Productivity loss estimates based on the FC approach are also always considerably lower than those calculated using the HC approach.

When examining only studies that followed a similar methodology to ours, the extent and composition of costs appear comparable. A recent study by Wenig et al. [48] based on a survey of a large sample of German citizens, estimated the societal costs of LBP to be 2.2% of the German GDP in 2005, without considering direct costs due to LBP-sufferers receiving assistance, or presenteeism, which were both shown to be particularly important in our study. The cost structure was also similar to that reported in the present study, with 46% direct costs and 54% productivity losses (HC approach). A study by Boonen et al. [3] estimated the cost of chronic LBP at 1.4% of the Dutch GDP in 2002. Considering that the latter study assessed productivity losses with the FC approach this estimate appears to be reasonably in line with our own findings. The societal costs of LBP in Switzerland appear smaller if international cost comparisons are carried out with exchange rates adjusted for purchasing power parity, as the price level in Switzerland is considerably higher than that in most other industrial countries.

The peculiarities of the Swiss Healthcare system might add plausibility to the results as they lead to higher direct medical costs than in other countries. Under the compulsory 100% health insurance coverage for all residents, patients have free choice in primary and secondary care and thus the possibility to directly visit a specialist, physiotherapist, or chiropractor without passing through a gatekeeper, such as the general practitioner or a HMO organization.

#### Utility of COI studies

In the last 20 years, several authors, such as Shiell et al. [42], Currie et al. [13], Drummond [15], Koopmanschap [26], and others have questioned the value of COI studies on the basis that they provide no additional information on the relevance of a given health problem that is not already contained in medical statistics (e.g. hospital admission, visits to specialists) and they do not investigate the most cost-effective measures to cure the disease in question. However, it should be noted that the assessment of

interventions aimed at prevention or treatment of LBP was beyond the scope of this study. Our goal was to adopt the COI methodology in considerable detail and we have made substantial efforts to collect data not readily available from national surveys. For instance, we took out-of-pocket expenditures and direct non-medical costs into account, as well as productivity losses because of presenteeism. Despite reservations regarding the theoretical value of the methodology (a ‘major headache’ according to Drummond [15]), well-known researchers accept the usefulness of comprehensive COI studies and international organizations, such as the OECD and the WHO commonly use this approach [2, 21, 37]. Furthermore, COI studies often serve as input for cost-effectiveness analyses [22].

#### Limitations

Several *limitations* of this study must be highlighted and these will be discussed in relation to whether they may have led to an underestimation or overestimation of costs.

First, the systematic differences between the study sample and the Swiss target population represent a weakness of the study. While the fact that the survey was limited to the German-speaking part of Switzerland does not appear to be too critical—as according to the Swiss Health Survey 2007 the prevalence of various back problems in this region (42.2% suffering from various back problems in the last 4 weeks) lies between the prevalence in the French (44.5%) and the Italian-speaking region (41.7%)—the fact that immigrants were so strikingly underrepresented in the sample might have serious consequences for the external validity of the survey. Furthermore, the immigrants who were included in our sample differed systematically from the average immigrant, as they possessed a good command of the German language, a requirement of their participation in this questionnaire study. Buri et al. [11] found evidence that individuals with an immigration background were more likely than native citizens to receive a disability pension in 2005. This selection bias thus most likely led to an *underestimation* of the total costs of LBP in Switzerland.

Second, individuals were asked if they were willing to participate in a survey on LBP. It seems plausible that individuals with more severe LBP would have been more inclined to volunteer for participation than others, and this element of self-selection may be expected to contribute to overestimation of the total costs of LBP. However, a non-response analysis for a similarly comprehensive survey of LBP in Germany [38] found only a relatively moderate (1 to 4%) upward bias of the LBP prevalence rate in the responders. This would have led to an overestimation of the costs of LBP of between 3.3 and 6.6% [48]. The present study does not indicate the reasons for non-responders, but

the high response rate of fully completed questionnaires is an indicator that *overestimation* should not be higher than mentioned above.

Third, we did not consider the higher costs of patients with private or semi-private insurance in addition to the compulsory basic insurance. These patients are charged considerably higher fees for hospital stays and some health services. As 9.8% of LBP sufferers have private insurance and 25.4% have semi-private insurance, this is likely to lead to an *underestimation* of the total costs of LBP.

Fourth, we did not account for the productivity losses due to LBP by individuals not belonging to the labour force, such as household workers, students and pensioners. This is likely to lead to an *underestimation* of the total costs of LBP.

Finally, as discussed in the section on the internal validity of the questionnaire, some respondents may have mistakenly reported not only the costs related to LBP, but also costs due to other illnesses. This may be expected to lead to an *overestimation* of the direct costs.

## Conclusion

This study elucidates two important components of socioeconomic costs of LBP.

First, a large proportion of the direct costs of LBP are shouldered by the individuals themselves (approximately 45%). Two out of three individuals suffering from LBP in the last 4 weeks do not seek any primary care. The distribution of direct costs of LBP is highly skewed to the right. Half of the individuals use minimal resources, but the remainder incur substantial out-of-pocket expenditure in attempting to alleviate their LBP. Although the average individual expenditure remains low for the majority of individuals, the high proportion of self-care among the population has a major impact on the assessment of total direct costs. In our study we had to rely on self-reported expenses, which by their very nature are often guesstimates. In order to improve the reliability of results, in future studies the real expense of health-related items should be assessed—in addition to the use of services covered by health insurance—by means of an adapted household-survey.

Second, the evaluation of productivity losses of LBP reveals that losses due to presenteeism are two to three times more important than losses due to absenteeism. This result is independent of the approach adopted to calculate productivity losses (HC or FC approach). The magnitude of these losses should motivate employers and policy makers to improve working conditions for employees with back pain in order to minimize their loss of productivity. In an age where all possible avenues for containing health-related losses

must be explored, presenteeism would appear to be one potential drain on resources that might have been underestimated [12, 31]. However, checking through the current literature, we see that employers seem to be starting to take a serious look at how the health of their employees affects the bottom line. There is a need to quantify the loss of production from the employer's point of view. Studies should be carried out to examine the extent to which employer-sponsored health management interventions can minimize the loss of productivity associated with LBP and whether there is enough return on investment to warrant action. In order to improve the reliability of results, worker productivity instruments should be applied to assess presenteeism [32] and easy-to-use questionnaires should be developed to determine how employee presenteeism affects profit.

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